Comparison of Fish Harvests From the East Arm of Great Slave Lake, N.W.T., By Itinerant Sport Anglers in 1986 and 1994

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PREFACE

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ABSTRACT

Low, G., D.B. Stewart, A.C. Day and W.E.F. Taptuna. 1999. Comparison of fish harvests from the east arm of Great Slave Lake, N.W.T., by itinerant sport anglers in 1986 and 1994. Can. Tech. Rep. Fish. Aquat. Sci. 2263: iv + 32 p.

The east arm of Great Slave Lake supports a highly regarded sport fishery for trophy-sized lake trout (*Salvelinus namaycush*). It also supports an Aboriginal food fishery and, in its western reaches, a commercial gillnet fishery. The trophy fishery is shared by guests at sport fishing lodges in the area and by "itinerant" anglers. The purpose of this study, undertaken in the area during the summers of 1986 and 1994, was to learn about the harvest by itinerant anglers. This information can then be included in the overall management plan for the east arm of Great Slave Lake. Response rates to the questionnaire survey were 57% in 1986, and 27% in 1994. Lake trout made up over 74% of the anglers' catch in both years, followed by Arctic grayling (*Thymallus arcticus*) and northern pike (*Esox lucius*). The anglers, mostly from Yellowknife, N.W.T., released >80% of their lake trout. Hearne Channel was the most frequently fished area during both years. Estimates generated from the survey suggest that the harvest of lake trout from the east arm by itinerant anglers increased from 712 in 1986 to 1,267 in 1994. If a 7% release mortality is factored in, the harvest mortality estimates would rise to 892 trout in 1986 and 1,694 in 1994. Further study is recommended to determine whether this increase is a trend.

Key words: Northwest Territories; lake trout; fishery management; sport fishing; catch statistics.

RÉSUMÉ

Low, G., D.B. Stewart, A.C. Day and W.E.F. Taptuna. 1999. Comparison of fish harvests from the east arm of Great Slave Lake, N.W.T., by itinerant sport anglers in 1986 and 1994. Can. Tech. Rep. Fish. Aquat. Sci. 2263: iv + 32 p.

Le bras est du Grand lac des Esclaves est un lieu de pêche sportive très recherchée pour la prise de touladi-trophées (*Salvelinus namaycush*). Il alimente une pêche de subsistance des Autochtones et, ses tronçons occidentaux, une pêche commerciale aux filets maillants. La pêche aux poissons-trophées est pratiquée par les clients des camps de pêche sportive de la région et par des pêcheurs à la ligne « itinérants ». La présente étude, menée dans la région pendant les étés de 1986 et de 1994, visait à connaître les captures effectuées par les pêcheurs à la ligne itinérants. Ces données peuvent alors être incluses dans le plan de gestion général du bras est du Grand lac des Esclaves. Le taux de réponse à l'enquête par questionnaire était de 57% en 1986, et de 27% en 1994. Le touladi représente plus de 74% des prises des pêcheurs à la ligne pour les deux années, suivi de l'ombre arctique (*Thymallus arcticus*) et du grand brochet (*Esox lucius*). Les pêcheurs à la ligne, provenant en grande partie de Yellowknife (T.N.-O.) ont remis à l'eau plus de 80% des touladis prélevés. Le chenal Hearne était la zone la plus fréquemment exploitée au cours des deux années. Selon les évaluations faites à partir de l'enquête, la capture de touladi par des pêcheurs à la ligne itinérants dans le bras est est passée de 712 en 1986 à 1267 en 1994. Si on prend en compte un facteur de mortalité due à la capture de 7%, les évaluations de la mortalité due à la capture passeraient à 892 touladis en 1986 et à 1694 en 1994. On recommande de poursuivre les études pour déterminer si cette augmentation constitue une tendance.

Mots-clés : Territoires du Nord-Ouest ; touladi ; gestion de la pêche ; pêche sportive; statistiques des captures.

INTRODUCTION

The Aboriginal food fishery, commercial lodges and outfitters, commercial gillnet fisheries and recreational fisheries all harvest a variety of fish species from the east arm of Great Slave Lake (Fig. 1). The most vulnerable of these species to over-harvesting is the lake trout (*Salvelinus namaycush*). Consequently, most fishery management efforts in the area have been directed at the lake trout fisheries, some of which remain poorly understood.

Most Aboriginal food fishing for trout in the east arm takes place near the community of Lutsel K'e (formerly Snowdrift) and, to a lesser extent, near Reliance. However, Aboriginal nets are occasionally set in other areas of the east arm, including the Hearne Channel area. By policy the federal Department of Fisheries and Oceans (DFO) does not issue non-Aboriginal Domestic Fishing Licences for area VI. The present extent of the Aboriginal harvest is unknown.

Great Slave Lake administrative area VI, which includes much of the east arm of the lake, has been closed to commercial fishing since 1974. However, commercial fishermen continue to gillnet lake trout from the eastern portion of area V, which includes the Hearne Channel area of the east arm, east to McKinley Point. Since the Simpson Islands commercial fish plant closed in 1992, the summer catch in area V has been delivered to the Wool Bay plant near Yellowknife (Fig. 1). Incidental catches of lake trout are also taken in the west basin of Great Slave Lake, and there is continued pressure to expand the fishery back into area VI of the east arm (Yaremchuk 1986; G. Pryznyk, pers. comm.).

The east arm supports a highly regarded lake trout sport fishery. Four sport fishing lodges operate in the area with a total capacity of 100 guest beds (B. Stoneman, pers. comm.). The area is also frequented by "itinerant" anglers who do not stay at the lodges. The latter include, among others, the guests of the five outfitters who are licenced to guide fishing trips into the east arm. Previous studies of the east arm sport fisheries have largely ignored the harvests by itinerant anglers (Falk et al. 1973, 1974a+b, 1975, 1982; Gillman and Roberge 1982; Moshenko and Gillman 1978a+b, 1983; Yaremchuk 1986).

In the early 1980's, fishery patrols in the east arm began to observe an increase in the number of itinerant anglers. In 1986, concerned by the lack of knowledge of this fishery and by its potential effects on trout stocks and sport lodges in the east arm, DFO and the Government of the Northwest Territories' Department of Resources, Wildlife and Economic Development conducted a joint study of the fishery. The purpose of this study was to learn about the fishery so that resource managers could consider harvests by itinerant anglers in their overall management plan for the east arm of Great Slave Lake. The study was repeated in 1994, to examine whether changes were occurring in the fishery. This report documents the results of these studies.

MATERIALS AND METHODS

STUDY AREA

The study area encompassed the east arm of Great Slave Lake (Fig. 1). Bounded on the west by the 113°30'W longitude meridian, it included all of DFO's Great Slave Lake administrative Areas V and VI.

In 1986, a field camp was established at "Doctors Cabin" (62°19'15" N, 111°55'30"W), on an unnamed island about 8 km northeast of Narrow Island (Fig. 2). It was staffed by two fishery technicians from 26 June to 5 September. The technicians actively patrolled the area using a 5.5 m Lund runabout powered by a 25 hp outboard motor. This combination afforded them the best access to shore camps.

In 1994, the field camp was established at Lady Jane Bay, on a foreland overlooking the Hearne Channel (61°59'40"N, 113°14'00"W) (Fig. 3). The change in camp location was in response to observations by DFO staff on patrol in the early 1990's, that some itinerant anglers were not travelling as far into the east arm as in 1986. Hearne Channel is the "marine highway" from Yellowknife into the east arm. All traffic that passed through it was visible from the camp, which was staffed by two fishery technicians from 30 June to 5 September. The technicians used a 5.5 m Boston Whaler powered by a 90 hp outboard to patrol the area. The change in powerboat enabled them to track the larger and faster boats used in the fishery. Between year differences in the camp location and boat were necessary to optimize survey coverage.

In both years, the camp locations were marked on the questionnaire map and announced on the Canadian Broadcasting Corporation's northern message broadcast. Two 4' x 8' sheets of

plywood, painted flourescent orange, marked the camps from the water. Anglers were encouraged to visit for a hot cup of coffee and free promotional hat.

In both years, field staff patrolled the most heavily used areas of the east arm to survey anglers. These patrols ranged from McKinley Point to Taltheilei Narrows and included heavily used areas near Narrow Island, Utsingi Point, and Etthen Island. In 1986, on the last day of most weekends, the field staff were positioned northwest of Narrow Island to intercept anglers travelling back to Yellowknife. In 1994, they were likewise positioned at Lady Jane Bay, but few anglers stopped. Instead, most boats were intercepted as they travelled eastward past Lady Jane Bay into the east arm; travellers were informed of the study and handed questionnaires.

Areas of the east arm outside the range of the daily camp patrols were visited by DFO Fishery Officers aboard the fishery patrol vessels M.V. Mirage and M.V. Christie Bay in 1986, and M.V. Tucho Mariner in 1994. They told anglers about the study and encouraged them to fill out questionnaires.

QUESTIONNAIRE SURVEYS

For both study years, data on the itinerant angler fishery were collected mainly using a survey questionnaire (Appendix 1). The only difference between the 1986 and 1994 questionnaires was the inclusion, in 1994, of a question on the use of barbless hooks. Distribution took place just prior to, and during, the fishing season, with most questionnaires being handed out by the field technicians during patrols in the study area. Anglers were asked to complete a separate questionnaire for each fishing trip.

In 1986, Fishery Officers patrolling the east arm on the M.V. Mirage and M.V. Christie Bay distributed questionnaires to anglers in Lutsel K'e and Reliance, and to the itinerant anglers they encountered on the lake. Packages of questionnaires were also delivered, for distribution, to: aircraft charter companies and cruise operators in Yellowknife and Hay River who transport itinerant anglers to the east arm; private boat owners known to frequent the area; the Yellowknife Yacht Club; the Department of National Defence camp at Utsingi Point; the Royal Canadian Mounted Police in Yellowknife; and the Canadian Coast Guard in Hay River.

In 1994, packages of questionnaires were again distributed to the aircraft charter companies and the Department of National Defence. These groups were seldom encountered on the lake in 1986, since they flew into the east arm by float equipped aircraft, and would have been missed by our survey staff. To avoid duplication and make the surveys easier to track, questionnaires were not distributed to the other groups which, in 1986, were often encountered on the lake. There was only one patrol by the M.V. Tucho Mariner into the east arm in 1994. Anglers encountered during the patrol were informed of the study but, to simplify distribution tracking, were not given questionnaires.

For both study years, a covering letter was attached to each questionnaire to explain the purpose of the survey. It described the location of the field camp and invited anglers to visit for a more detailed creel census. A map included with each questionnaire depicted the location of the field camp. Anglers were asked to mark their fishing locations on the map and to return it with the questionnaire.

To encourage return of the questionnaires, anglers were given a pre-addressed, postage-paid return envelope. To facilitate their distribution and control, each questionnaire and envelope was marked with a serial number. A record was kept, by serial number, of each questionnaire distributed. At the end of the fishing season the various groups or individuals were asked to return or account for their questionnaires. Those who returned a questionnaire were eligible for a free prize draw on a spin-casting rod and reel kit.

The number of anglers missed by the study is unknown, but considered to be small because it was well advertised, blank questionnaires were issued to regular users of the area, and almost all boats in the east arm were checked by the fishery technicians or Fishery Officers on patrol. The location of the DFO base camps made it difficult for anglers to travel undetected into or out of the east arm. Some resident anglers from Lutsel K'e may have been missed as well as some who travelled into the east arm from communities other than Yellowknife, or visited outside the study period.

Estimates of the total harvest were calculated as the sum of the catches of anglers who returned completed surveys and the predicted catches of anglers who were given forms but did not return them. Anglers who did not return their forms were assumed to have had success equal to those that did. The validity of this assumption was

examined, for 1986 only, by comparing the creel census results (see below) with the questionnaire results.

CREEL CENSUS

In 1986, a partial creel census was conducted simultaneous with the questionnaire survey to check for bias in the survey method. Unlike the questionnaire survey, the creel census was based on direct observation of the angler's harvest by DFO personnel. It was therefore assumed to be relatively unbiased. The census also provided an opportunity to collect biological data from the anglers' catch. Creel census techniques were adapted from Falk et al. (1973), and were consistent with methods used in previous studies of the east arm lodge fishery. Anglers who checked in at the field camp, or were encountered on the lake or interviewed at their camp at the end of the fishing day, were asked for information on their place of residence; the number of each fish species caught, released, or kept; and the number of hours spent fishing. They were also given a survey questionnaire which they were encouraged to complete at the end of their fishing trip.

A creel census was not conducted in 1994 due to logistical constraints. Fewer anglers than expected stopped at the field camp. Most anglers were in a hurry to return to Yellowknife at the end of their trip. The field camp was also distant from other camping areas, making it impractical to interview campers on a regular basis. Bias in the 1994 questionnaire survey results was assumed to be similar to that estimated for the 1986 survey.

BIOLOGICAL SAMPLING

In 1986, a portion of the angler's catch of lake trout was sampled for fork length (± 1 mm), round weight (± 50 g), sex, maturity, and stomach contents. Maturity stages were determined according to the method reported by Falk et al. (1982), as described in Appendix 2.

Sagittal otoliths were collected for age determination. They were stored dry in envelopes marked with sample information. In the laboratory, the convex surface of each otolith was ground on a fine carborundum stone. The otoliths were then immersed in a 3:1 solution of benzyl-benzoate and methyl salicylate, on a depression slide, and the annual growth rings were counted using a dissecting microscope. The trout were aged according to the method of Grainger (1953), where the dark central core is considered to represent the first winter's growth.

The condition factor (K), a relative measure of the plumpness or robustness of a fish, was determined for each fish using the following formula:

$$K = (\text{round weight in g} \times 10^{5}) \div \text{fork length in mm}^{3}$$

WEATHER DATA

A weather log was maintained at the field camp for the duration of the 1986 and 1994 studies. Weather observations were recorded daily at 1000 h and 2200 h. The observer estimated percent cloud cover, wind direction and velocity, and wave conditions. Weather-related travel conditions for small craft were rated based on the observer's experience.

RESULTS

QUESTIONNAIRE SURVEYS

In 1986, DFO distributed 612 questionnaire surveys to charter operators, outfitters, and potential anglers. At the end of the survey, 338 of these forms were unused because the operators and outfitters had not given them to anglers or they had been given to anglers who did not go fishing. Of the remaining 274 surveys that were given to anglers prior to or during their fishing trips to the east arm of Great Slave Lake, 157 were completed and returned to DFO. Only two of these forms were spoiled and not included when summarizing the data, the rest were carefully completed.

In 1994, between 30 June and 5 September, 587 questionnaire surveys were distributed, mostly by DFO technicians but also by air charter companies, directly to anglers who were travelling to the east arm of Great Slave Lake to sport fish. Questionnaires were not given to 89 occupants of these boats who were not planning to fish in the area. The anglers returned 156 completed questionnaires to DFO, none of which were spoiled.

In both years, an unknown number of anglers may have been missed by the survey as they visited the area via Lutsel K'e or Fort Resolution, passed unseen at night or during bad weather, or visited the area outside the study period. This number was considered to be small relative to the number of anglers surveyed.

The response rates to the questionnaire surveys were 56.6% in 1986, and 26.6% in 1994. These relatively high rates of response to a questionnaire survey likely reflect the active method of distributing the questionnaires in the field. In both years, most questionnaires were returned by mail.

HARVEST

Anglers who responded to the 1986 survey (56.6%) caught 1,859 lake trout (Tables 1 and 3). They harvested (kept) 403 of these fish (21.7%). Assuming that the anglers who did not complete and return their surveys (43.4%) were equally successful, the estimate of total harvest by the itinerant sport fishery was 712 lake trout. Lake trout were the main species harvested, and accounted for 79% of the overall catch.

Anglers who responded to the 1994 survey (26.6%) caught 1,961 lake trout (Tables 2 and 3). They harvested 337 of these fish (17.2%). Assuming that the anglers who did not complete and return their surveys (73.4%) were equally successful, the estimate of total harvest by the itinerant sport fishery was 1,267 lake trout. Lake trout were the main species harvested, and accounted for 75% of the overall catch.

Northern pike (*Esox lucius*) made up 8% of the angler's catch in 1986. Anglers who responded to the survey caught 185 pike, of which they harvested 7 or 3.8%. In 1994, northern pike made up 17% of the angler's catch. Anglers who responded to the survey caught 453 pike, of which they harvested 11 or 2.4%. The total harvest of pike by the itinerant sport fishery was not calculated for either year.

In 1986, Arctic grayling (*Thymallus arcticus*) made up 12% of the angler's catch. Anglers who responded to the survey caught 280 grayling, of which they harvested 150 or 53.6%. In 1994, Arctic grayling made up 8% of the angler's catch. Anglers who responded to the survey caught 200 grayling, of which they harvested 57 or 28.5%. The total harvest of grayling by the itinerant sport fishery was not calculated for either year.

Anglers surveyed in 1986 caught 4 inconnu (*Stenodus leucichthys*), 4 lake cisco (*Coregonus artedii*), and 2 lake whitefish (*Coregonus clupeaformis*). Those surveyed in 1994 caught 2 lake whitefish and 3 walleye (*Stizostedion vitreum*).

The overall number of fish caught per angler day (3.9 cf. 4.5) or hour (0.7 cf. 1.0) was slightly lower in 1986 than in 1994 (Tables 1 and 2). Similar differences were observed in the lake trout catch per unit effort. Unfortunately, the significance of these apparent differences cannot be interpreted from the data available.

RELEASE RATE

Most fish caught by itinerant anglers in the east arm were released back to the water (Table 3). In 1986 the estimated release rates were 78.3% (2,572 fish) for lake trout, 96.2% for northern pike and 46.4% for Arctic grayling. In 1994, the estimated release rates were 82.8% (6,105 fish) for lake trout, 97.6% for northern pike and 71.5% for Arctic grayling. The rates of mortality for each species following their release and inter-year differences in mortality of released fish were not determined.

CREEL CENSUS

Between 5 July and 6 September 1986, 191 anglers (215 angler days) were surveyed by partial creel census. A creel census was not conducted in 1994 due to logistical problems. There was close agreement between the overall number of lake trout caught per angler day (3.4 cf. 3.1) or hour (0.56 cf. 0.60) by anglers involved in the 1986 creel census or questionnaire survey, respectively (Tables 1 and 4). Similar agreement was not found for Arctic grayling or northern pike.

BIOLOGICAL SAMPLING

In 1986, a total of 110 lake trout were sampled from the itinerant angler's creel (Tables 5 and 6). The mean (n = 110) fork length was 655 mm (range 510 to 968 mm) and round weight was 3,771 g (range 1,050 to 12,500 g). The mean age (n = 63) was 15.6 y (range 11 to 22 y), and the mean condition was 1.25. Biological sampling was not undertaken in 1994.

FISHING LOCATIONS

Two changes were observed in the pattern of the locations fished by itinerant anglers between 1986 and 1994 (Fig. 2 and 3). In 1986, the north shore of Hearne Channel from south of Narrow Island east to Utsingi Point, and along the northwest coast of Etthen Island was the area of the east arm most commonly fished. In 1994, this area was still important but it extended further west along the north coast of Hearne Channel. More anglers also reported having fished waters of the east arm due east of Blanchet Island in 1994 than in 1986. These differences in fishing area do not mean that lake trout harvest statistics are not comparable between the two study years.

Most anglers travelled from Yellowknife in privately owned small craft, ranging from open boats with outboard motors to cabin cruisers and sailboats. Some anglers were on trips organized by local cruise boat outfitters, operating from Yellowknife, while others flew in on chartered or privately owned aircraft. Many of the anglers were on business in the area and took advantage of their off-duty hours to fish in the east arm. Their range from Yellowknife into the east arm was often limited by fuel to the Narrow Islands - Utsingi Point area. Others were able to venture further into the east arm by taking advantage of fuel caches or refuelling in Lutsel K'e. The fuel range of boats likely accounts for the intensive angling in Hearne Channel and the fact that few anglers ventured further into McLeod and Christie bays (Fig. 2 and 3).

ANGLER RESIDENCE

Over 82% of the anglers who responded to the 1986 and 1994 surveys resided in the Northwest Territories, most in Yellowknife (Table 7). Less than 18% of the itinerant anglers were from outside the Northwest Territories. This is in sharp contrast to the lodge-based sport fishery which attracts mainly anglers from outside the Northwest Territories.

ANGLER EXPERIENCE AND FISHING QUALITY

Among anglers who responded to the 1986 survey and had fished the east arm in previous years, 34% believed that the quality of the fishing was worse than in the past, 44% the same, and 22% better (Table 8). Among anglers who responded to the 1994 survey and had fished the east arm in previous years, 18% believed that the quality of the fishing was worse than in the past, 66% the same, and 16% better.

WEATHER

During the 1986 study period, 27 June to 4 September--when almost all itinerant harvest takes place, weather in the east arm was rated as good for small boat travel for at least part of the day 84% of time, fair 11%, and poor 4% of the time (Appendix 3). During the 1994 study period, 30 June to 5 September, it was rated as good 81% of the time, fair 17%, and poor 2% of the time, with 5 days when the data were not recorded. Smoke from forest fires was common in 1994 until mid-August.

DISCUSSION

SOURCES OF ERROR

Questionnaire surveys are subject to three types of survey error: sampling error, response bias, and non-response error (Polluck et al. 1994). Sampling errors arise due to improper sampling selection, under-coverage, duplication, and other biases. Response error results mainly from recall bias and intentional deceptions including over-reporting of catches due to prestige bias (Macdonald and Dillman 1968). Non-response error occurs when anglers who receive questionnaires refuse to answer for whatever reason.

We believe that the sampling error in this survey was very small. Extensive knowledge of the timing and user category composition of the fishery was incorporated into the study design. It enabled us to accurately target the user group and to provide thorough coverage of the fishery. Based on our knowledge, we believe that perhaps 90% of the itinerant anglers who fished in the east arm in 1986 and 1994 were given questionnaire surveys.

The percentage of anglers not receiving a questionnaire was greater in 1994 than in 1986. Due to an early thaw, the Hearne Channel was ice free a week earlier than usual, allowing earlier access to the fishery. An undetermined number of anglers fishing in the east arm during the weekend of June 23rd/24th were missed by the 1994 survey. Also, in 1994 fewer questionnaires than expected

were passed out to anglers flying into the east arm by charter aircraft. These omissions likely caused a relatively small underestimation of anglers using the area and of resulting fish harvest estimates.

The similarity of lake trout catch and effort results between the 1986 questionnaire and creel census support our view that the response error had little effect on the harvest statistics generated by this study (see text table below). Response or recall bias may, however, have contributed to the large differences observed between the results of the 1986 creel and questionnaire survey for non-target species, such as Arctic grayling and northern pike.

Between and within year comparisons of survey parameters.

SURVEY METHOD	Lake trout	Arctic grayling	Northern pike
Percentage of fish kept:			
1986 Questionnaire	21.7	53.6	3.8
1986 Creel census	20.8	16.7	52.5
1994 Questionnaire	17.2	28.5	2.4
1994 Creel census	-	-	-
Catch per unit effort (fish caught per angler per day):			
1986 Questionnaire	3.1	0.5	0.3
1986 Creel	3.4	<0.1	0.2
1994 Questionnaire	3.3	0.3	0.8
1994 Creel	-	-	-
Harvest estimate (number of fish):			
1986 Questionnaire	712	n/a	n/a
1994 Questionnaire	1267	n/a	n/a

- no creel census was conducted in 1994.

Jacobson et al. (1983) report that recall bias for fishing effort is related to the timeliness of the questionnaire and the amount of information requested. Recall should not have been a problem for anglers filling out a short simple form soon after a memorable fishing trip into the east arm of Great Slave Lake. Most questionnaires were handed directly to the angler during the fishing trip. The angler was not expected to remember information from several trips and the recall period was short. In both years, most questionnaires were received by DFO shortly after the trip date, indicating that they were filled out soon after the trip ended.

Non-response is a universal problem associated with surveys that require voluntary response (Jacobson et al. 1983). Successful anglers, for example, are much more likely to respond to a survey than unsuccessful anglers. This can result in an over-estimation of the catch, catch per unit effort, and harvest. The greatest potential error in this study is due to the possible introduction of non-response error. Murphy (1954) found that the rate of return of the postal surveys designed to measure angler catch and effort influenced the final results of his surveys. This bias was not totally eliminated until he reached a response rate of 84 to 91 percent. Anderson and Thompson (1991) had an average response rate of 66% (range 40-87) in their angler diary study of the Great Bear Lake lodge fishery. By applying a correction factor, determined during a pilot study that included a phone survey to measure and correct for non-response bias, they were able to calculate catch per unit effort and the lake trout harvest with accuracy sufficient for management purposes. Mills (1981) was satisfied with a 66% response rate for a questionnaire survey to estimate effort and harvest for major Alaskan sport fisheries, when it was combined with on-site creel census programs.

Results from questionnaire surveys should be verified by on-site studies such as active creel censuses--as they were for this study in 1986. Care must be taken in interpreting data gathered by this method. Jacobson et al. (1983) concur with Hiett and Worrall (1977) that as much information as possible should be collected from on-site surveys, and that the recall period for reporting trips should be as short as possible.

The response rates to the questionnaire surveys were 56.6% in 1986, and 26.6% in 1994. These were relatively high considering the large size of the study area and its logistical constraints and are due to the active method of distributing questionnaires to anglers in the field. Reasons for the difference in response rate between 1986 and 1994 are not known, but may be due to the

differences in approach by field staff. In 1986, the survey crew was a married couple who worked the survey from start to finish except for a brief period in mid-study. Their location allowed them to visit camps and to establish a rapport with the fishermen. The 1994 crew consisted of four young men who worked alternating weeks on two man shifts. Because of their location they had to intercept anglers on their way to fishing areas, so their contact was very brief and did not allow for an in-depth discussion of the study or fishing in general. The surveyors did not develop as good a rapport with the anglers who probably did not have the same level of commitment to the study as they did in 1986.

We believe that non-response bias had little effect on the harvest statistics generated for lake trout by this study. This view is supported by the similarity of lake trout catch per unit effort results between the 1986 questionnaire and creel census (see text table above).

Both response and non-response bias may have contributed to the large differences observed between the results of the 1986 questionnaire survey and creel census for non-target species, such as Arctic grayling and northern pike (see text table above). In consequence, harvest estimates were not calculated for these species.

Weather was good for small boat travel 84% of the time in 1986, and 81% of the time in 1994. The similarity of these observations supports the validity of between year comparisons of the results of this study. Neither the observed increase in the harvest nor differences in the areas fished can be attributed to differences in weather.

If the weather had been different between years, it would have been very difficult to draw conclusions from comparisons of the survey results. For example, if bad weather in 1986 had limited travel by small boat and forced anglers to fish in less favourable fishing areas but access to these area was improved by good weather in 1994, then the observed increase in harvest would be an artifact of weather.

Conclusions drawn from between year comparisons of catch per unit effort statistics are also strengthened by our observation that the suitability of the weather for small boat travel was similar in 1986 and 1994.

Changes in the pattern of fishing locations between 1986 and 1994 may be artifacts of the change in field camp location (Fig 2 and 3). The 1994 field camp was moved about 50 km closer to Yellowknife, near the mouth of Hearne Channel. This meant that the 1994 patrols were more likely to survey itinerant anglers near the mouth of Hearne Channel and to intercept those passing south of Blanchet Island, than were the 1986 patrols. It is perhaps equally likely that these changes result from real differences in fishing patterns in response to changes in powerboat technology and/or the pattern of the commercial fishery. Whatever their cause, these modest changes are unlikely to account for the increase in harvest by the itinerant anglers observed from 1986 to 1994.

Angler residence varied little between 1986 and 1994. This is important since it too supports the validity of comparing the results of the 1986 and 1994 surveys. For example, if a different population of anglers were surveyed in 1994 than in 1986, between year comparisons may be confounded by between year differences in angler expertise, response bias, non-response bias and sampling error.

HARVEST ESTIMATES

The estimate of 712 lake trout harvested by the 1986 itinerant fishery probably has a low level of error given the relatively high response rate of 56.6%, thorough survey coverage of the fishery, and close agreement of the 1986 creel and questionnaire survey results. The 1994 estimate of 1,267 lake trout harvested is more vulnerable to error bias, due to the lower response rate (26.6%), but this bias could not be quantified without a simultaneous creel census. Close agreement of the lake trout catch effort data between the 1986 and 1994 surveys, however, suggests that the 1994 estimate also had a low level of error. Because these estimates do not factor in release mortality, the actual number of fish killed by the fishery is likely to be much greater.

More than twice as many anglers were intercepted and surveyed in 1994 as in 1986, and the harvest estimates suggest that twice as many trout were harvested in 1994. These data strongly support observations by the Fishery Officers and DFO concern that there has been a significant increase in the number of itinerants and in their trout harvest in the east arm of Great Slave Lake in the short period of 8 years.

Because itinerant anglers release a high proportion of their catch, any release mortality contributes significantly to the number of fish killed by the fishery. Falk et al. (1974c) reported a 7% mortality rate for released lake trout. Assuming that there was a similar rate of mortality for the lake trout caught and released during this study, the 1986 harvest estimate would be increased by 180 (i.e. 7% of 2,572 released trout) from 712 to 892 trout, and the 1994 estimate by 427 (i.e. 7% of 6,105 fish released) from 1,267 to 1,694 trout. These amount to increases in lake trout harvest mortality of 25% in 1986 and 34% in 1994.

The 1986 release rate statistics for lake trout likely have low error levels as indicated by the agreement between the questionnaire survey and creel census. We assume that lake trout release statistics derived from the 1994 questionnaire survey are relatively unbiased since they were collected in the same manner as the release rate statistics from the 1986 questionnaire survey.

Considering the high release rate for the itinerant angler fishery, any effort to reduce mortality would benefit fish stocks. The promotion or legislation of the use of barbless hooks will reduce mortality. An existing video which illustrates the proper catch and release handling of lake trout should be made available to as wide an audience as possible. DFO should also work to develop additional educational programs with the involvement of groups such as the N.W.T. Fish and Game Association.

Anglers surveyed in 1986 and 1994 had similar responses to questions regarding the quality of the lake trout sport fishery. For both of the survey years, the majority of anglers reported that they believed the quality of the fishery had remained the same for the period of years in which they had been fishing in the east arm.

IMPLICATIONS FOR MANAGEMENT

These are the first estimates of the harvest by itinerant anglers from the east arm. As such, they enable fishery managers to better consider the itinerant sport fishery in the overall management plan for the area.

Lake trout sport fishing areas have been well defined by this study and by Yaremchuk (1986). If the high quality of the area VI lodge fisheries and abundant stocks for Aboriginal fisheries are to be maintained, the total allowable harvest (TAC) must be set at the appropriate optimum level. With information on the surface area of the sport fishing grounds, the sustainable trout yields per hectare (see Healey 1975), and the harvests of lodge, itinerant and Aboriginal fisheries, an optimum sustainable yield could be estimated. DFO and co-managers would then be able to allocate a share of the total allowable catch (TAC) to the various fisheries. At present, however, the harvest by Aboriginal fisheries is unknown, the itinerant angler harvest may be increasing, and harvest estimates from the lodge-based fishery are almost two decades old. The prediction of a time at which total harvests will reach the optimum sustainable yield and start to compromise the quality of the area VI lake trout trophy fishery is needed. It would be greatly improved and refined by the addition of harvest data from the Aboriginal food fishery, another comparable study of the itinerant angler fishery in 2002 that includes a creel census, and comparable data from the lodge based sport fishery.

Itinerant anglers and commercial gillnet fishers share a significant portion of their fishing grounds in area V but not in other areas of the east arm. The commercial trout harvest in the area has declined from a mean of 89 tonnes for the 5 year period ending in 1981, to a mean of 31 tonnes for the 5 year period ending in 1996 (Table 9). Lower production is attributed to less fishing effort in the area and not to declining stocks. There has been a shift in fishing effort away from the southeastern portion of area V (Simpson Islands, Union Island, Keith Island) to the northwest portion of the area including the Hearne Channel. In summer, the area V catch is delivered to the Wool Bay fish plant near Yellowknife. The Simpson Islands fish plant which previously serviced area V, was closed in 1992 and will remain closed until there is a need to access fish stocks in the area. While the commercial harvest in the area has decreased over-all, it may not have decreased in the area shared with the itinerant anglers.

The Hearne Channel, west of McKinley Point, is the area of greatest interaction between itinerant anglers and the commercial fishery. Commercial fishermen complain of nets being damaged by outboard motors and are concerned that they might be injured by fish hooks while pulling nets. Anglers complain about snagging their hooks and boat propellers in nets and are concerned about the effects of commercial fishing on the trout stocks.

It is unrealistic to manage area V as a high quality trophy fishery since there is an active commercial gillnet fishery in this area.

Anglers and commercial fishers have few conflicts in area VI which is closed to commercial fishing and managed as a trophy lake trout fishery. Conflict amongst the lodge-based fishery, the Lutsel K'e Aboriginal food fishery, and the itinerant angler fishery is possible if levels of harvest increase for any of these fisheries. If area VI is to be managed as a high quality sport fishery, trout harvest must be maintained at a low level and distributed over a large area to ensure the survival of large trophy trout. Yaremchuk (1986) reported that there was little or no potential for increasing the harvest taken by the sport lodge industry without decreasing fishing quality.

The establishment of a marina in the east arm has been discussed by various individuals and organizations. While existing boat traffic cannot support such a venture, the establishment of a new National Park which has been proposed for the east arm--on the peninsulas between Christie and McLeod bays, would likely lead to a significant increase in the boat traffic. Infrastructure to serve these people, such as a marina, would also improve the access of itinerant anglers into the east arm, and thereby increase demands on the trophy trout stocks. It might also alter fishing patterns by making hitherto remote areas better accessible. "Progress on the East Arm National Park has been stalled for some time. ... Parks Canada expects to resume discussion on this park proposal with the people of Lutsel K'e at the appropriate time in the Treaty 8 land entitlement negotiations." (New Parks North, March 1996).

RECOMMENDATIONS

1) Once land claims affecting the area are settled, a management plan should be developed for the east arm of Great Slave Lake to address the future use of the fishery resource. In the interim, area VI should continue to be managed with the objective of maintaining a high quality trophy fishery and abundant stocks for Aboriginal fisheries in a management zone separate from the rest of Great Slave Lake. Area V fish stocks should be managed for a medium quality sport fishery shared with the commercial fishery and the small amount of Aboriginal fishing that occurs there. This recommendation is consistent with current use of the east arm.

2) The mandatory use of barbless hooks should be a legislated requirement for the Great Slave Lake sport fishery. An educational program should be developed with itinerant angler groups to improve fish handling techniques and reduce release mortality.

3) This study should be repeated in 2002 to determine if the reported increase in the itinerant angler fishery is a trend. The study design should be comparable to the 1986 and 1994 surveys. It should include a creel census and facilitate analyses of the data from areas V and VI separately and combined so that differing management goals for the areas can be addressed.

4) Harvest levels should be estimated for the lodge-based fishery and the Aboriginal food fishery, preferably in the same year as a repeat survey of the itinerant fishery is conducted.

5) An optimum sustainable yield for lake trout should then be estimated for area VI.

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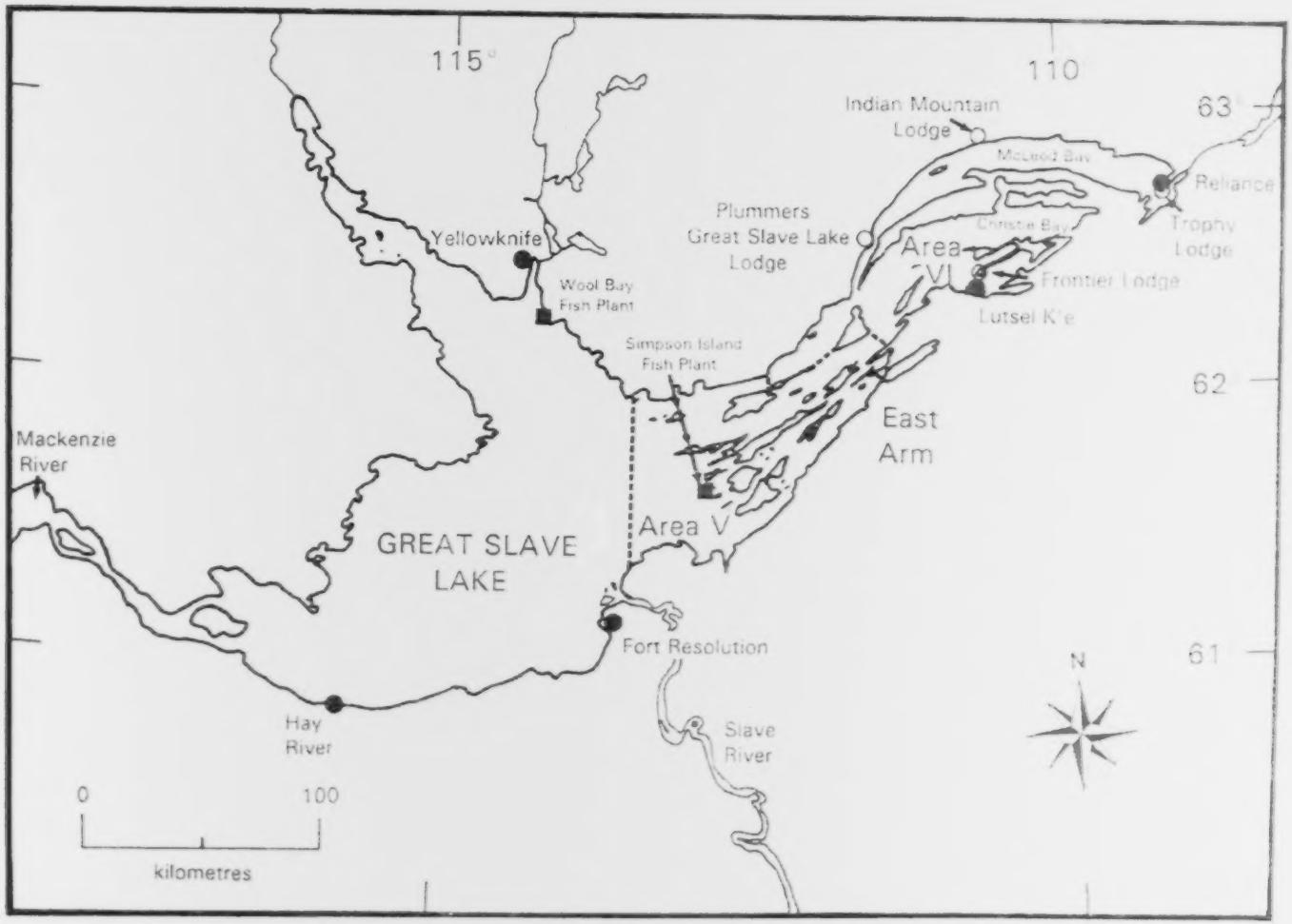


Figure 1. Map of Great Slave Lake, N.W.T.

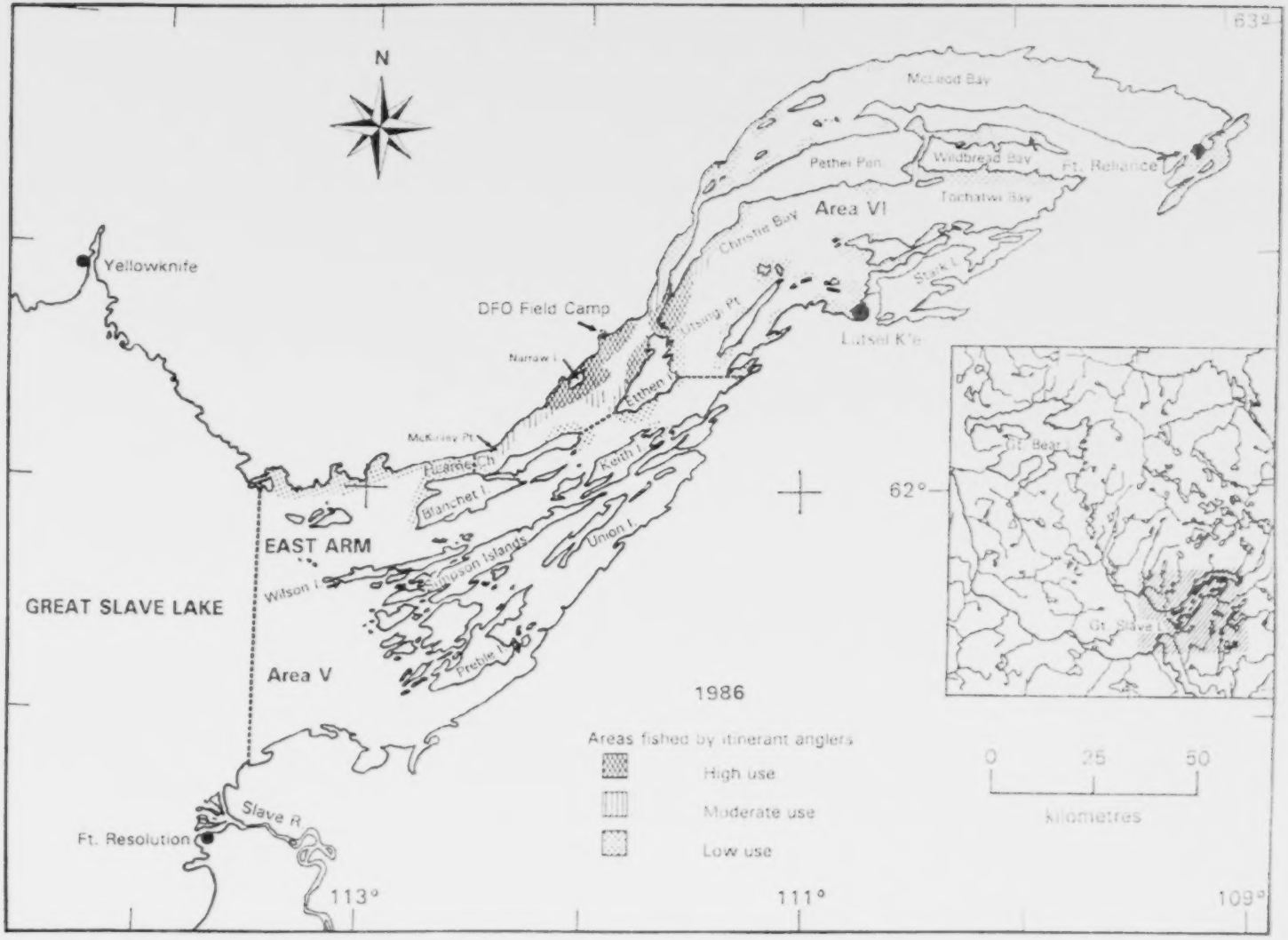


Figure 2. Areas of the east arm of Great Slave Lake, N.W.T., frequented by itinerant sport anglers in the summer of 1986.

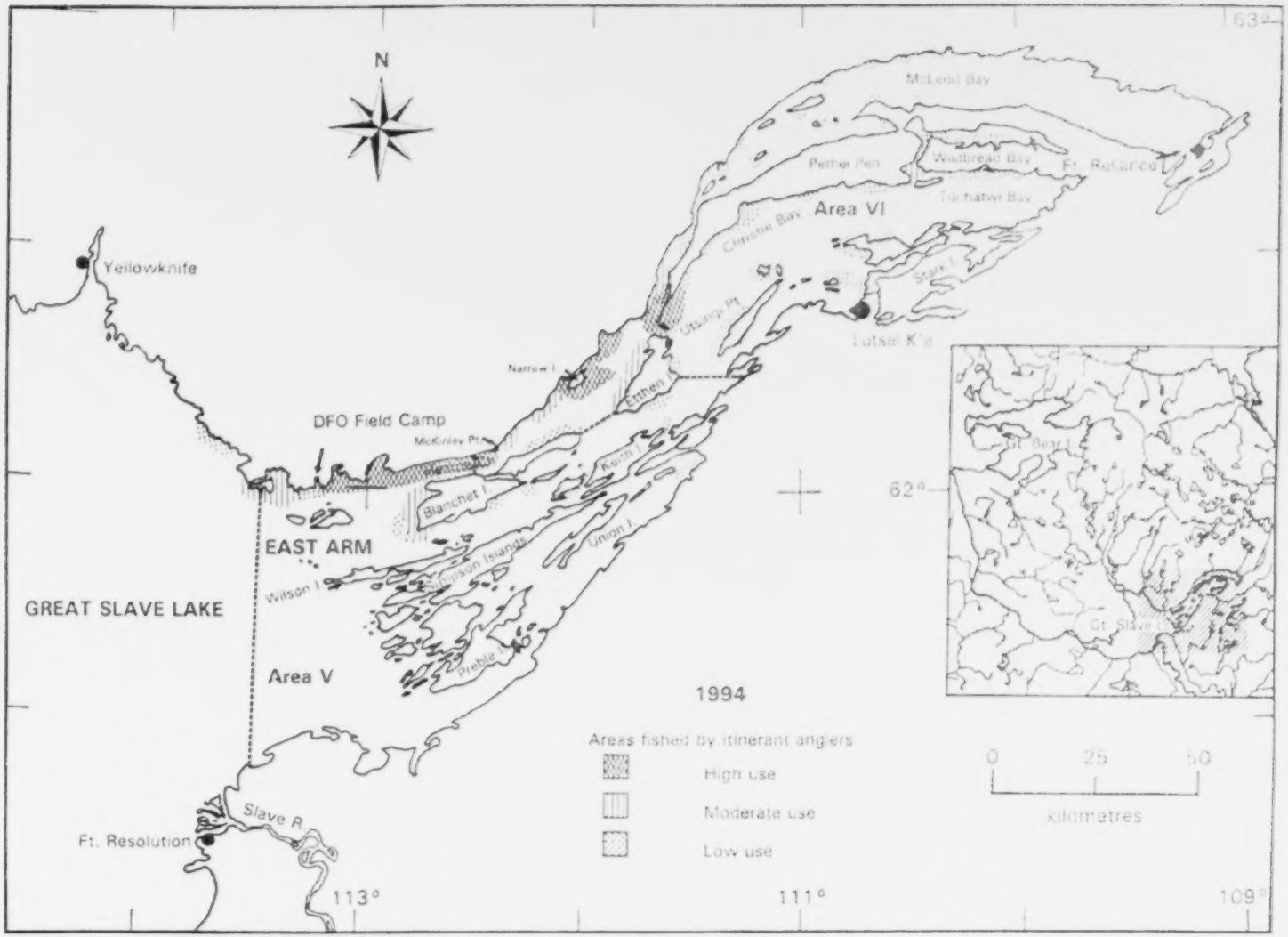


Figure 3. Areas of the east arm of Great Slave Lake, N.W.T., frequented by itinerant sport anglers in the summer of 1994.

Table 1. Catch summary from the questionnaire survey of the east arm of Great Slave Lake itinerant sport fishery, 1986.

DATE (week ending)	ANGLERS SURVEYED (#)	ANGLER DAYS (#)	SUCCESS RATE (%)	LAKE TROUT (#)			NORTHERN PIKE (#)			ARCTIC GRAYLING (#)			OTHER SPECIES[4] (#)			FISHING EFFORT (h)	FISH CAUGHT (#)	
				C[1]	R[2]	K[3]	C	R	K	C	R	K	C	R	K		per angler day	per angler hour
July 5	29	116	93	354	276	78	37	36	1	28	4	24	3	2	1	682.5	3.6	0.6
July 12	29	78	97	213	143	70	13	13	0	26	4	22	0	0	0	393	3.2	0.6
July 19	22	76	100	320	274	46	44	42	2	45	33	12	5	3	2	563.5	5.4	0.7
July 26	6	20	100	15	11	4	1	1	0	0	0	0	0	0	0	74	0.8	0.2
August 2	17	59	100	195	168	27	87	83	4	17	6	11	2	1	1	450.5	5.1	0.7
August 9	23	128	96	317	238	79	2	2	0	70	22	48	3	3	0	525	3.1	0.7
August 16	4	29	100	134	121	13	0	0	0	39	16	23	3	0	3	168	6.1	1.0
August 23	11	31	100	76	50	26	0	0	0	37	31	6	1	0	1	145.5	3.7	0.8
August 30	3	6	100	51	44	7	0	0	0	10	8	2	0	0	0	47	10.2	1.3
September 6	5	11	100	29	18	11	0	0	0	0	0	0	0	0	0	49	2.6	0.6
undated	6	50	100	155	113	42	1	1	0	8	6	2	0	0	0	160	3.3	1.0
Total[5]	155	604	97	1859	1456	403	185	178	7	280	130	150	17	9	8	3258.5	-	-
Mean[6]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.9	0.7
% Kept				21.7			3.8			53.6			47					
Fish caught per angler day (#)[6]				3.1			0.3			0.5			<0.1					
Fish caught per angler hour (#)[6]				0.60			0.06			0.09			<0.01					

[1] Number caught
[2] Number released
[3] Number kept
[4] Other species caught were inconnu, cisco sp. and whitefish sp.
[5] For "success rate" the total is the overall total, not the column total.
[6] These are simple means based upon the overall catch and effort totals, they are not column means.

Table 2. Catch summary from the questionnaire survey of the east arm of Great Slave Lake itinerant sport fishery, 1994.

DATE (week ending)	ANGLERS SURVEYED (#)	ANGLER DAYS (#)	SUCCESS RATE (%)	LAKE TROUT (#)			NORTHERN PIKE (#)			ARCTIC GRAYLING (#)			OTHER SPECIES[4] (#)			FISHING EFFORT (h)	FISH CAUGHT (#)	
				C[1]	R[3]	K[2]	C	R	K	C	R	K	C	R	K		per angler day	per angler hour
July 5	54	180.5	92.6	744	601	143	347	344	3	81	50	31	0	0	0	856.5	6.5	1.4
July 12	31	158	96.8	642	561	81	9	9	0	68	60	8	0	0	0	899	4.6	0.8
July 19	18	74	100	211	177	34	2	2	0	7	4	3	0	0	0	267	3.0	0.8
July 26	19	75	89.5	151	107	44	1	1	0	31	23	8	4	0	4	263	2.5	0.7
August 2	16	53	87.5	155	138	17	84	83	1	12	6	6	1	1	0	301	4.8	0.8
August 9	6	11	66.7	1	1	0	7	0	7	0	0	0	0	0	0	51	0.7	0.2
August 16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
August 23	6	13	83.3	22	18	4	2	2	0	0	0	0	0	0	0	48	1.8	0.5
August 30	1	1	100	2	0	2	0	0	0	0	0	0	0	0	0	1	2	2
September 6	1	2	100	19	18	1	0	0	0	0	0	0	0	0	0	9	9.5	2.1
undated	4	21	75	14	3	11	1	1	0	1	0	1	0	0	0	36	0.8	0.4
Total[5]	156	588.5	92.3	1961	1624	337	453	442	11	200	143	57	5	1	4	2730.5	-	-
Mean[6]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.5	1.0
% Kept				17.2			2.4			28.5			80					
Fish caught per angler day (#)[6]				3.3			0.8			0.3			<0.1					
Fish caught per angler hour (#)[6]				0.72			0.17			0.07			<0.01					

[1] C = number caught
[2] R = number released
[3] K = number kept
[4] Other species caught were lake whitefish and walleye
[5] For "success rate" the total is the overall total, not the column total.
[6] These are simple means based on the overall catch and effort totals, they are not column means.

Table 3. Reported harvest and estimated total harvest of lake trout, northern pike and Arctic grayling from the east arm of Great Slave Lake by itinerant anglers in 1986 and 1994.

	1986 SURVEY						1994 SURVEY					
Questionnaires distributed (#)	274						587					
Questionnaires returned (#)	155[1]						156					
Response rate (%)	56.6						26.6					
SPECIES	REPORTED HARVEST			ESTIMATED TOTAL HARVEST[5]			REPORTED HARVEST			ESTIMATED TOTAL HARVEST		
	C[2]	R[3]	H[4]	C	R	H	C	R	H	C	R	H
lake trout	1859	1456	403	3284	2572	712	1961	1624	337	7372	6105	1267
northern pike	185	178	7	-[6]	-	-	453	442	11	-	-	-
Arctic grayling	280	130	150	-	-	-	200	143	57	-	-	-

[1] Two spoiled questionnaires are not included in the 1986 total.
[2] C = number of fish caught
[3] R = number of fish released
[4] H = number of fish harvested (kept)
[5] The total estimated harvests were calculated by dividing reported harvest by the proportion of the questionnaires distributed which were completed and returned (e.g. for lake trout in 1986: 1859 lake trout were reported caught/0.566 of the questionnaires distributed were completed and returned = an estimated total of 3284 lake trout were caught)
[6] Harvest estimates were not calculated for northern pike and Arctic grayling.

Table 4. Creel census of the east arm of Great Slave Lake itinerant sport fishery, 1986.

DATE (week ending)	ANGLERS SURVEYED (#)[4]	ANGLER DAYS (#)	SUCCESS RATE (%)	LAKE TROUT (#)			NORTHERN PIKE (#)			ARCTIC GRAYLING (#)			FISHING EFFORT (h)	FISH CAUGHT (#)	
				C[1]	R[2]	K[3]	C	R	K	C	R	K		per angler day	per angler hour
July 5	61	74	82	189	141	48	9	3	6	17	14	3	417	2.9	0.5
July 12	34	34	100	172	147	25	11	6	5	-	-	-	259	5.4	0.7
July 19	34	34	100	132	108	24	9	3	6	-	-	-	239	4.2	0.6
July 26	4	8	50	18	11	7	-	-	-	-	-	-	56	2.3	0.3
August 2	4	8	50	15	15	0	-	-	-	-	-	-	32	1.9	0.5
August 9	11	16	67	20	12	8	-	-	-	-	-	-	66.5	1.2	0.3
August 16	10	12	83	42	33	9	-	-	-	-	-	-	63	3.5	0.7
August 23	24	24	100	104	84	20	4	0	4	1	1	0	109.5	4.5	1.0
August 30	2	2	100	1	0	1	7	7	0	-	-	-	4	4.0	2.0
September 6	7	9	78	27	19	8	-	-	-	-	-	-	45	3.0	0.6
Total[5]	191	215	89	720	570	150	40	19	21	18	15	3	1291	-	-
Mean[5]	-	-	-	-	-	-	-	-	-	-	-	-	-	3.6	0.6
% Kept				20.8			52.5			16.7					
Fish caught per angler day (#)[6]				3.4			0.2			<0.1					
Fish caught per angler hour (#)[6]				0.56			0.03			0.01					

[1] C = number caught
[2] R = number released
[3] K = number kept
[4] Anglers were creeled on a daily basis. An angler creeled more than one day was counted as a separate angler for each day creeled.
[5] For "sucess rate" the total is the overall total, not the column total.
[6] These are simple means based upon the overall catch and effort totals, they are not column means.

Table 5. Age composition of lake trout sampled during the 1986 creel census of the east arm of Great Slave Lake itinerant sport fishery.

AGE	MALES							FEMALES							COMBINED					
(y)		Length (mm)		Weight (g)		K	Mat (%)		Length (mm)		Weight (g)		K	Mat (%)		Length (mm)		Weight (g)		K
	n	mean	SD	mean	SD			n	mean	SD	mean	SD			n	mean	SD	mean	SD	
11	1	663	-	4150	-	1.42	100	1	495	-	1230	-	1.01	0	4	605	77	2783	1201	1.19
12	2	583	103	2525	1379	1.20	50	1	538	-	2100	-	1.35	0	3	568	77	2383	1005	1.25
13	5	590	99	2710	1697	1.21	80	2	561	8	2225	389	1.26	50	7	581	82	2571	1414	1.22
14	9	568	72	2289	1231	1.17	67	4	637	63	3488	864	1.33	75	14	598	79	2746	1233	1.21
15	3	612	34	2483	881	1.13	67	3	682	63	3750	1182	1.15	100	6	647	59	3117	1162	1.14
16	4	655	65	3413	920	1.22	100	2	707	139	4475	2722	1.18	100	7	681	80	3886	1417	1.20
17	3	648	62	3600	1510	1.27	67	5	635	54	3430	934	1.31	100	10	632	51	3490	1076	1.35
18	1	734	-	5000	-	1.26	100	-	-	-	-	-	-	-	1	734	-	5000	-	1.26
19	1	636	-	3300	-	1.28	100	1	668	-	4200	-	1.41	100	2	652	23	3750	636	1.35
20	2	649	84	3775	1591	1.34	100	2	719	69	5050	2546	1.30	100	4	684	75	4413	1883	1.32
21	1	676	-	3950	-	1.28	100	-	-	-	-	-	-	-	2	741	91	3950	-	1.28
22	-	-	-	-	-	-	-	2	694	59	4975	1803	1.45	100	2	694	59	4975	1803	1.45
23	1	656	-	3950	-	1.40	100	-	-	-	-	-	-	-	1	656	-	3950	-	1.40
TOTAL	33							23							63					
MEAN		615	75	3000	1288	1.23			645	79	3623	1471	1.28			632	78	3283	1348	1.25
MEAN AGE	15.4							16.1							15.6					

Table 6. Length composition of lake trout sampled during the 1986 creel census of the east arm of Great Slave Lake itinerant sport fishery.

LENGTH INTERVAL (mm)	MALES						FEMALES						COMBINED				
		Length (mm)	Weight (g)		K	Mat (%)		Length (mm)	Weight (g)		K	Mat (%)		Length (mm)	Weight (g)		K
	n	mean	mean	SD			n	mean	mean	SD			n	mean	mean	SD	
450-474	-	-	-	-	-	-	-	-	-	-	-	-	1	452	1050	-	1.14
475-499	-	-	-	-	-	-	1	495	1230	-	1.01	0	1	495	1230	-	1.01
500-524	5	511	1580	152	1.18	40	-	-	-	-	-	-	5	511	1580	152	1.18
525-549	4	538	1838	111	1.18	100	3	543	2017	104	1.26	33	7	540	1914	138	1.21
550-574	6	564	2208	540	1.22	67	3	561	2283	293	1.29	67	10	562	2220	429	1.25
575-599	7	590	2614	276	1.28	86	2	579	2425	35	1.25	100	12	590	2717	518	1.32
600-624	5	616	2820	603	1.21	60	9	613	3100	624	1.35	100	15	614	2990	588	1.29
625-649	5	637	2950	893	1.13	80	1	646	3150	-	1.17	100	10	638	3140	636	1.21
650-674	4	662	3688	450	1.27	100	8	662	3794	521	1.30	88	12	662	3758	480	1.29
675-699	2	680	3350	849	1.07	100	1	691	3600	-	1.09	100	3	683	3433	617	1.08
700-724	2	711	5050	212	1.41	50	4	714	4563	489	1.26	100	7	712	4657	460	1.29
725-749	4	732	5100	324	1.30	100	3	736	5283	861	1.32	100	8	734	4913	912	1.24
750-774	1	758	5650	-	1.30	100	4	768	5638	839	1.25	75	5	766	5640	727	1.26
775-799	-	-	-	-	-	-	-	-	-	-	-	-	1	790	7500	-	1.52
800-824	-	-	-	-	-	-	5	815	5030	1588	0.93	80	5	815	5030	1588	0.93
825-849	-	-	-	-	-	-	1	848	8400	-	1.38	100	3	837	9533	1835	1.63
925-949	-	-	-	-	-	-	-	-	-	-	-	-	1	947	11400	-	1.34
950-974	1	955	10200	-	1.17	100	-	-	-	-	-	-	2	962	11375	1662	1.28
TOTAL	46						45						108				
MEAN		621	3118	1600	1.22			670	3871	1524	1.24			653	3755	2133	1.25

Table 7. Place of residence of itinerant anglers surveyed in the east arm of Great Slave Lake in 1986 and 1994.

ANGLER RESIDENCE	1986 SURVEY		1994 SURVEY	
	#	%	#	%
N.W.T. (Yellowknife)	137 (120)	88.4 (77.4)	128 (123)	82.1 (78.8)
Alberta	8	5.2	13	8.3
Ontario	5	3.2	3	1.9
British Columbia	2	1.3	2	1.3
Manitoba	1	0.6	2	1.3
Saskatchewan	0	0	3	1.9
Minnesota	1	0.6	1	0.6
Germany	1	0.6	0	0
United Kingdom	0	0	1	0.6
Unknown	0	0	3	1.9
TOTAL	155		156	

Table 8. Anglers ratings of the quality of fishing in the east arm of Great Slave Lake, in 1986 and 1994, relative to their previous experience(s) fishing in the area.

ANGLER EXPERIENCE (y)[1]	1986 QUALITY RATING (# of anglers)			1994 QUALITY RATING (# of anglers)		
	WORSE	SAME	BETTER	WORSE	SAME	BETTER
2[2]	10	10	9	6	7	8
3	9	12	2	2	3	2
4	2	3	1	2	14	1
5	1	4	0	2	15	2
6	-	-	-	0	5	2
7	3	0	3	0	4	0
8	1	3	1	1	0	2
9	0	1	1	1	4	0
10	2	2	0	2	8	0
11	-	-	-	0	1	0
12	0	0	1	0	1	0
13	1	1	0	1	0	0
15	0	1	0	0	4	0
16	-	-	-	0	0	1
18	-	-	-	2	2	0
20	0	1	1	0	2	0
21	-	-	-	0	4	0
22	-	-	-	0	1	0
25	1	0	0	-	-	-
30	-	-	-	1	0	0
TOTAL (#)	30	38	19	20	75	18
Percent (%)	34	44	22	18	66	16

[1] Years of fishing in the east arm of Great Slave Lake

[2] Anglers fishing for the first year in the east arm are not included in this table.

Table 9. Commercial harvest of lake trout (tonnes round weight) from area V of Great Slave Lake, N.W.T., 1976 to 1995.

YEAR	WINTER	SUMMER	TOTAL
1976/77	0	107	107
1977/78	0	73	73
1978/79	17	66	83
1979/80	23	80	103
1980/81	2	76	78
5-year total (mean)			444(89)
1981/82	3	67	70
1982/83	0	54	54
1983/84	0	40	40
1984/85	0	92	92
1985/86	1	85	86
5-year total (mean)			342(68)
1986/87	0	87	87
1987/88	13	28	41
1988/89	0	78	78
1989/90	12	28	40
1990/91	5	38	43
5-year total (mean)	- Simpson Islands fish plant closed -		289(58)
1991/92	0	16	16
1992/93	0	33	33
1993/94	0	2	2
1994/95	21	25	46
1995/96	15	45	60
5-year total (mean)			157 (31)

APPENDIX 1 Covering letter and questionnaire for the 1986 and 1994 summer surveys of itinerant anglers who fished the east arm of Great Slave Lake, N.W.T..

Northwest Territories Economic Development and Tourism

Government of Canada / Gouvernement du Canada
Fisheries and Oceans / Pêches et Océans

P.O. Box 1008
Hay River, NWT
X0E 0R0

Dear Angler:

The Department of Economic Development and Tourism, Government of the Northwest Territories, and the Federal Department of Fisheries and Oceans are conducting a creel census program in the east arm of Great Slave Lake. The purpose of the program is to provide information useful in the long-term management of the sport fishery. We are requesting your cooperation in completing the enclosed questionnaire on sports fishing.

The questionnaire is designed to obtain information on fishing activity in the east arm area such as the amount of time spent fishing, as well as the number of fish caught, released and retained. We welcome your comments on the present and future management of the fishery. All information recorded will remain confidential. We will send you a copy of the survey results upon request.

A creel census check-point will be operated at the cabin north-east of Narrow Island. All anglers travelling beyond this point are requested to check in on their return trip for a more detailed creel census. Our staff will collect your questionnaire and briefly interview you on your fishing activities. So stop in for a friendly chit-chat - the coffee is usually on. Fisheries and Oceans promotional caps will be given out while the supply lasts.

Watch for the orange shore marker and our 5-meter patrol boat. We are looking forward to seeing you on the lake. Good fishing!

Chief of Tourism
Government of the
Northwest Territories

Manager of Field Services
Fisheries and Oceans

SERIAL NUMBER 337

QUESTIONNAIRE ON SPORT FISHING IN THE

EAST ARM OF GREAT SLAVE LAKE

EACH person in the fishing party should fill out a separate questionnaire for each fishing trip.

1. Date(s) of fishing trip in East Arm _____.

2. Number of days fished _____ days.

3. Number of hours spent fishing on this trip _____ hrs.

4. Location(s) fished _____.
(mark on enclosed map please)

5. How many of each of the following fish species did you, yourself, catch and retain?

Species	Caught	Released	Kept/Consumed
Lake Trout	_____	_____	_____
Northern Pike	_____	_____	_____
Arctic Grayling	_____	_____	_____
Walleye (pickerel)	_____	_____	_____
Other (specify)	_____	_____	_____

6. How many years have you fished in the East Arm? _____ yrs.

7. How do you rate this year's fishing compared with previous years?

Same ☐ Better ☐ Not as good ☐

8. Place of residence:
Community, if in the NWT _____.

Province, state or country _____.

9. How many individuals were in your fishing party? _____.

10. Do you have any comments concerning the present or future direction of sport fishery management on Great Slave Lake?

_____

_____ (over)

11. Would you like a copy of the survey results? Yes ☐ No ☐

Address: _____.

12. Have you fished previously in the East Arm this year?

Yes ☐ No ☐

13. Were you surveyed for previous trip(s)? Yes ☐ No ☐

14. If NO ☑ please fill out a separate questionnaire(s) for these trip(s).

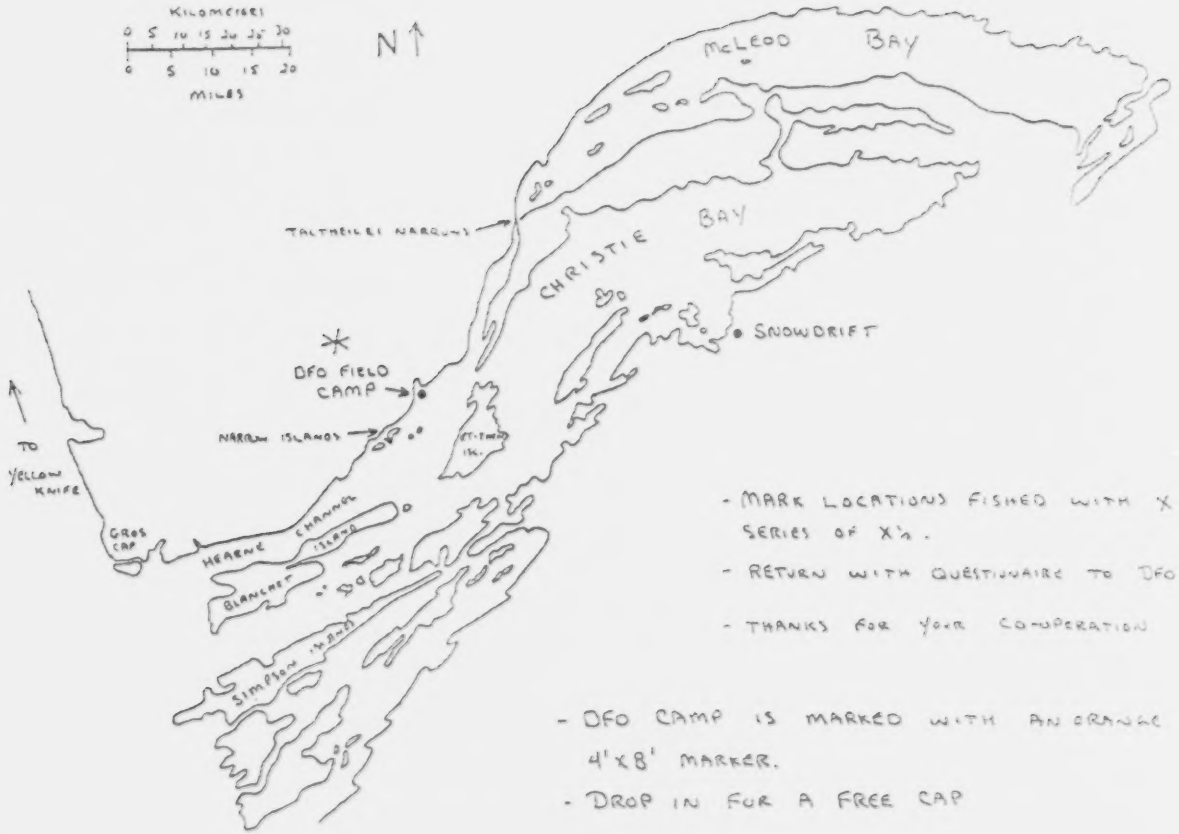
Please return this questionnaire to our staff at:

The DFO field camp marked on the map or if that is not possible mail it to us in the envelop provided.

Fisheries and Oceans
Box 1008
Hay River, NWT
X0E 0R0

GREAT SLAVE LAKE
EAST ARM

SPORT FISHERY SURVEY

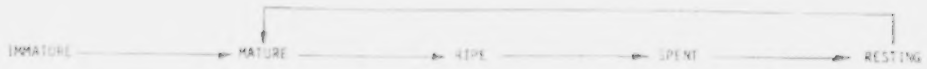


- MARK LOCATIONS FISHED WITH X OR SERIES OF X's.
- RETURN WITH QUESTIONAIRE TO DFO CAMP
- THANKS FOR YOUR COOPERATION

- DFO CAMP IS MARKED WITH AN ORANGE 4'x8' MARKER.
- DROP IN FOR A FREE CAP

APPENDIX 2 A description of the relative stages of maturity used for northern fish (from Falk et al. 1982).

MATURITY FLOW CHART



FISH MATURITY CODE

Maturity Stage		Female		Male
Immature (virgin)	1	-Ovaries granular in texture -hard and triangular in shape -up to full length of body cavity -membrane firm -eggs distinguishable	6	-Testes long and thin -tubular and scalloped shape -up to full body length -putty like firmness
Mature	2	-Current year spawner -ovary fills body cavity -eggs near full size but not loose -not expelled by pressure	7	-Current year spawner -testes large and lobate -white to purplish color -centers may be fluid -milt not expelled by pressure
Ripe	3	-Ovaries greatly extended & fill body cavity -eggs full size and transparent -expelled by slight pressure	8	-Testes full size -white and lobate -milt expelled by slight pressure
Spent	4	-Spawning complete -ovaries ruptured and flaccid -seed eggs visible -some retained eggs in body cavity	9	-Spawning complete -testes flaccid with some milt -blood vessels obvious -testes violet-pink in color
Resting	5	-Ovary 40-50% of body cavity -membrane thin, loose, & semi-transparent -healed from spawning -seed eggs apparent with few atretic eggs -some eggs may be retained in body cavity	10	-Testes tubular, less lobate -healed from spawning -no fluid in center -usually full length -mottled and purplish in color
Unknown (Virgin)	0	-cannot be sexed -gonads long or short & thin -transparent or translucent		
Unknown (non-virgin)	11	-resting fish -has spawned but gonads regenerated -sexing not possible		

Appendix 3. Weather in the east arm of Great Slave Lake during the 1986 and 1994 itinerant angler surveys.

DATE	1986 SURVEY							1994 SURVEY						
	DAY OF THE WEEK	AIR TEMPERATURE (°C)		% CLOUD COVER	WIND DIRECTION AND VELOCITY	WAVE CONDITIONS	RATING FOR SMALL BOAT TRAVEL	DAY OF THE WEEK	AIR TEMPERATURE (°C)		% CLOUD COVER	WIND DIRECTION AND VELOCITY	WAVE CONDITIONS	RATING FOR SMALL BOAT TRAVEL
		Max	Min						Max	Min				
June 27	Fri	18	8	75	0	calm	good							
28	Sat	19	7	10	S 5-10	calm-choppy	good-fair							
29	Sun	21	6	5	SW 5	light chop	good-fair							
30	Mon	21	7	0	S 5-10	calm-choppy	good-fair	Thurs			0	SW 5	calm	good
July 1	Tues	21	7	0	S 5-10	light chop	good	Fri			0	SE 20	light chop	good
2	Wed	19	9	100	SE 5	light chop	good	Sat			LS-S	SE 20	light chop	good
3	Thurs	21	9	100	SE 5-10	calm-choppy	good-fair	Sun			S	SE 10-15	light chop-choppy	good-fair
4	Fri	21	9	0-50	SE 10	rough	poor	Mon			0	SE 10	light chop	good
5	Sat	24	9	10-30	SE 5-15	calm-rough	good-poor	Tues			0-S	SE 5-15	calm-light chop	good
6	Sun	24	9	0-20	0	calm	good	Wed			0	SE 5	calm	good
7	Mon	22	9	0-5	0	calm	good	Thurs			S-70	SE 5-20	calm-light chop	good
8	Tues	26	11	80	SE 5	light chop	good	Fri			LS-70	SW 10-SE 15	light chop	good
9	Wed	25	11	10-100	0	calm	good	Sat			50-70	SE 5-10	light chop	good
10	Thurs	25	12	0	SE 5	light chop	good	Sun			S-70	0-SE 35	calm-choppy	good-fair
11	Fri	27	12	0-100	0	calm	good	Mon			50-80	SW 4-SE 10	calm	good
12	Sat	28	13	0	0	calm	good	Tues			0-100	0-NE 10	calm-light chop	good
13	Sun	35	14	0	0	calm	good	Wed			5-10	W 5 - SE 10	calm	good
14	Mon	30	10	0-100	SE 5-10	choppy-rough	fair-poor	Thurs			0	W 5-SW 5	calm	good
15	Tues	25	6	0	SE 0-10	calm-rough	good-poor	Fri			0	0-SE 10	calm-light chop	good
16	Wed	26	9	0-60	0	calm	good	Sat			0-5	SW 5-SE 5	calm	good
17	Thurs	20	8	0-80	S 5-10	choppy-rough	fair-poor	Sun			75-95	0-SE 5	calm	good

Appendix. 3. Continued.

DATE	1986 SURVEY							1994 SURVEY						
	DAY OF THE WEEK	AIR TEMPERATURE (°C)		% CLOUD COVER	WIND DIRECTION AND VELOCITY	WAVE CONDITIONS	RATING FOR SMALL BOAT TRAVEL	DAY OF THE WEEK	AIR TEMPERATURE (°C)		% CLOUD COVER	WIND DIRECTION AND VELOCITY[1]	WAVE CONDITIONS	RATING FOR SMALL BOAT TRAVEL
		Max.	Min.						Max.	Min.				
18	Fri	19	9	100	S 5-10	choppy-rough	fair-poor	Mon			S-80	SE 25-30	choppy-rough	fair-poor
19	Sat	19	9	50-100	0	calm	good	Tues			S	SE 10-15	light chop	good
20	Sun	19	5	80-100	NW 5-10	choppy	fair	Wed			0	SW 10-15	light chop-choppy	good-fair
21	Mon	30	9	100	0	calm	good	Thurs			10-95	SW 10-15	light chop	good
22	Tues	22	10	20-50	SE 5-10	choppy-rough	fair-poor	Fri			0-40	NW 20	light chop	good
23	Wed	22	6	70-100	SE 0-5	calm-light chop	good	Sat			0	SW 20	light chop	good
24	Thurs	25	10	0-70	SE 0-5	calm-light chop	good	Sun			15	SW 10	calm	good
25	Fri	22	6	10-50	NW 0-10	calm-light chop	good	Mon			0	SW 20	calm	good
26	Sat	22	12	0-70	S 5-10	calm-rough	good-poor	Tues			0-S	SW 10	calm	good
27	Sun	24	11	0	0	calm	good	Wed			0-S	0-SW 20	calm-light chop	good
28	Mon	23	12	0-100	SE 5-10	choppy-rough	fair-poor	Thurs			0-S	W 5-10	calm	good
29	Tues	18	12	100	0	calm	good	Fri			0-S	S 5-SE 20	calm-rough	good-poor
30	Wed	25	11	0-50	NW 5-10	calm	good	Sat			0-S	SE 25	moderately rough	fair
31	Thurs	19	13	0	0	calm	good	Sun			S	SE 15	choppy	fair
Aug 1	Fri	22	14	0-50	SE 0-5	calm-choppy	good-fair	Mon			S	SE <5	calm	good
2	Sat	21	13	15-50	SE 0-5	calm-choppy	good-fair	Tues			0	SE 35	rough-very rough	poor
3	Sun	25	15	0	0	calm	good	Wed			0	SE 10-15	light chop	good
4	Mon	22	12	100	0	calm	good	Thurs			S	S 10	calm	good
5	Tues	27	11	5-20	SE 0-10	calm-choppy	good-fair	Fri			100	SE 30	moderately rough	fair
6	Wed	19	14	5-90	S 0-10	calm-choppy	good-fair	Sat			0	E 20-30	moderately rough	fair

Appendix. 3. Continued.

DATE	1986 SURVEY							1994 SURVEY						
	DAY OF THE WEEK	AIR TEMPERATURE (°C)		% CLOUD COVER	WIND DIRECTION AND VELOCITY	WAVE CONDITIONS	RATING FOR SMALL BOAT TRAVEL	DAY OF THE WEEK	AIR TEMPERATURE (°C)		% CLOUD COVER	WIND DIRECTION AND VELOCITY[1]	WAVE CONDITIONS	RATING FOR SMALL BOAT TRAVEL
		Max	Min						Max	Min				
7	Thurs	17	8	80-100	SE 0-5	calm-choppy	good-fair	Sun			S	SE 25	calm	good
8	Fri	17	11	80-100	E 0-5	calm-choppy	good-fair	Mon			S	NW 15	light chop	good
9	Sat	25	10	5-30	E 0-5	calm-choppy	good-fair	Tues			S	S 10	calm	good
10	Sun	25	10	5-20	SE 0-5	calm-choppy	good-fair	Wed			S	0	calm	good
11	Mon	26	15	5-40	SW 0-10	calm-choppy	good-fair	Thurs			-	-	-	-
12	Tues	25	9	70-100	0	calm	good	Fri			-	-	-	-
13	Wed	24	15	15-100	0	calm	good	Sat			0	SE 10-15	light chop	good
14	Thurs	15	9	100	E 5	choppy	fair	Sun			S	SE <5	calm	good
15	Fri	17	9	25-100	SE 0-10	calm-rough	good-poor	Mon			90-100	SE <5-NE 10-15	calm-choppy	good-fair
16	Sat	18	7	90-100	0	calm	good	Tues			50	SE <5	calm	good
17	Sun	19	10	10-80	SE 5	calm-choppy	good-fair	Wed			0	SW <5	calm	good
18	Mon	24	10	100	SE 0-5	calm-choppy	good	Thurs			30	N 5-10	calm	good
19	Tues	20	7	20-70	NW 0-5	calm	good	Fri			100	NE 10-15	light chop	good
20	Wed	17	10	70-100	S 5-10	choppy	fair	Sat			20	SE 15-20	choppy	fair
21	Thurs	17	8	20-100	S 5-10	choppy	fair	Sun			0	25-30	moderately rough	fair
22	Fri	20	11	0-50	S 0-10	calm-rough	poor	Mon			-	-	-	-
23	Sat	15	6	60-100	NW 0-10	calm-choppy	good-fair	Tues			100	N <5	calm	good
24	Sun	19	8	0-100	NW 0-10	calm	good	Wed			100	N 30-35	moderately rough	fair
25	Mon	20	5	0-30	S 0-5	calm	good	Thurs			60	N 5-10	calm	good
26	Tues	20	10	0-10	0	calm	good	Fri			-	-	-	-
27	Wed	22	10	20-100	0	calm	good	Sat			-	-	-	-
28	Thurs	23	12	0-30	S 0-5	calm-choppy	good-fair	Sun			0	SE 20-25	moderately rough	fair

Appendix. 3. Continued.

DATE	1986 SURVEY							1994 SURVEY						
	DAY OF THE WEEK	AIR TEMPERATURE (°C)		% CLOUD COVER	WIND DIRECTION AND VELOCITY	WAVE CONDITIONS	RATING FOR SMALL BOAT TRAVEL	DAY OF THE WEEK	AIR TEMPERATURE (°C)		% CLOUD COVER	WIND DIRECTION AND VELOCITY[1]	WAVE CONDITIONS	RATING FOR SMALL BOAT TRAVEL
		Max	Min						Max	Min				
29	Fri	25	7	0-100	W 0-15	calm-rough	good-poor	Mon			0	E 10	calm	good
30	Sat	27	9	5-100	W 0-10	calm	good-poor	Tues			0	S 20	choppy	fair
31	Sun	15	8	0	0	calm	good	Wed			0	S 10-15	calm	good
Sept 1	Mon	18	10	100	SE 0-5	calm	good	Thurs			0	SE 30	moderately rough	fair
2	Tues	12	9	100	N 0-5	calm	good	Fri			0	SE 10	light chop	good
3	Wed	17	5	0-80	SE 0-5	calm	good	Sat			20	SE 10	light chop	good
4	Thurs	16	5	0-50	S 0-10	calm-rough	good-poor	Sun			50	NW 10	light chop	good

[1] calm = ripples = good travel conditions
light chop = no whitecaps = good travel conditions
choppy = some whitecaps = fair travel conditions
moderately rough = whitecaps and swells = fair travel conditions
rough = large whitecaps and swells = poor travel conditions
very rough = dangerous waves conditions for small craft = poor travel conditions
[2] S = smoky
[3] N = north, S = south, E = east, W = west

APPENDIX 4. Summary of comments by itinerant anglers who fished the east arm of Great Slave Lake, N.W.T..

Anglers surveyed in 1986 (n=155) and 1994 (n=156), were asked to comment on the present or future direction of sport fishery management on Great Slave Lake. Most of their comments were directed at the east arm commercial fishery, sport fishing limits, and DFO management programs.

In both years, a number of the itinerant anglers surveyed (1986, n = 35 ; 1994, n = 28) indicated that they would like to see commercial fishing in the east arm limited. They typically proposed either closure of part or all of the east arm to commercial fishing, or the elimination of gillnetting in general.

Comments on the daily catch and possession limits for sport fishermen were also common. The status quo seems to be preferred, since the majority indicated that the limits should be maintained (1986, n = 6; 1994, n = 6), and equal numbers of anglers requested that the limits be raised (1986, n = 4) or lowered (1986, n = 4; 1994, n = 1). A significant number of anglers indicated that they would like stricter enforcement of the angling limits (1986, n = 11; 1994, n = 4) and more patrols by DFO (1994, n = 2).

A number of anglers (1986, n = 4; 1994, n = 5) indicated that the east arm should be maintained in its natural state. They suggested, for example, that limits might be placed on access to the area and that existing campsites be cleaned up. In 1986, six of the itinerant anglers also indicated that they were opposed to further sport fishing lodge development on Great Slave Lake.

In 1986, eight anglers indicated that they supported the use of barbless hooks. These comments were not in response to a directed question. In 1994, those surveyed were asked whether they used barbless hooks, and whether they would support the legislated use of only barbless hooks in the Northwest Territories. Sixty-one responded that they always used barbless hooks, 48 that they sometimes used barbless hooks, and 45 that they did not use barbless hooks. The majority of those surveyed supported legislation which would allow only barbless hooks to be used in the Northwest Territories (yes, n = 100; no, n = 47). One respondent suggested that there be different licence fees for anglers who use barbed and barbless hooks, and another that treble hooks be banned altogether. In 1994, five anglers suggested that anglers be encouraged to release their catch, particularly trout in the 5 to 10 kg size ranges.

Respondents indicated that DFO management and monitoring programs should be maintained or increased (1986, n = 11; 1994, n = 14). DFO was also complemented on the 1986 (n = 5) and 1994 (n = 3) itinerant angler survey programs. One angler suggested that there should be more and better navigation buoys in the east arm.